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Farnell

TM4 A.C. VOLTMETER

INSTRUCTION BOOK

INSTRUCTION BOOK FOR

TM4 A.C. VOLTMETER

FARNELL INSTRUMENTS LIMITED · SANDBECK WAY · WETHERBY LS22 4DH · YORKSHIRE · ENGLAND. TELEPHONE 0937 3541-6

Price 50p

Issue 1 2-73

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SCHEDULE OF EQUIPMENT

The instrument has been carefully packed to prevent damage in transit. When you remove the unit from the box, be sure that you remove all parts and accessories from the packing material.

The complete equipment comprises:-

a) 1 off TM4 voltmeter

b) 1 off Instruction book

Optional accessories

a) X10 and X1 R.C. passive probe kit (Greenpar GE81600) is available from Farnell Instruments Limited.

Note:- In event of damage in transit or shortage in delivery, separate notices in writing should be given to both the carriers and Farnell Instruments Ltd. within three days of receipt of the goods, followed by a complete claim within five days. All goods which are the subject of any claim for damage in transit or shortage in delivery should be preserved intact as delivered, for a period of seven days after making the claim, pending inspection or instructions from Farnell Instruments Ltd. or an agent of this Company.

INTRODUCTION

The Farnell TM4 voltmeter accurately measures a.c. voltages from 300uV to 100V f.s.d. at frequencies up to 25MHz. The meter scales are calibrated in r.m.s. values for sinusoidal inputs although the instrument is fundamentally mean rectified reading.

Loading of the circuit under test is minimised by the instruments high input impedance. This may be further reduced by coupling a X10 oscilloscope probe to the B.N.C. socket on the front panel marked 'input'. To facilitate the compensation of such a probe to the input of the TM4, a fixed amplitude high frequency source is available from the socket on the front panel marked 'probe cal'. The usefulness of the TM4 may be extended still further by the use of an active probe which will provide a higher input impedance and more gain. Power for a probe of this type is available from a miniature3 pin socket on the front panel.

A switched filter is provided to remove unwanted and irrelevant high frequency signals and noise when making low frequency measurements. The filter starts rolling off at approximately 100kHz at a rate of 20dB per decade.

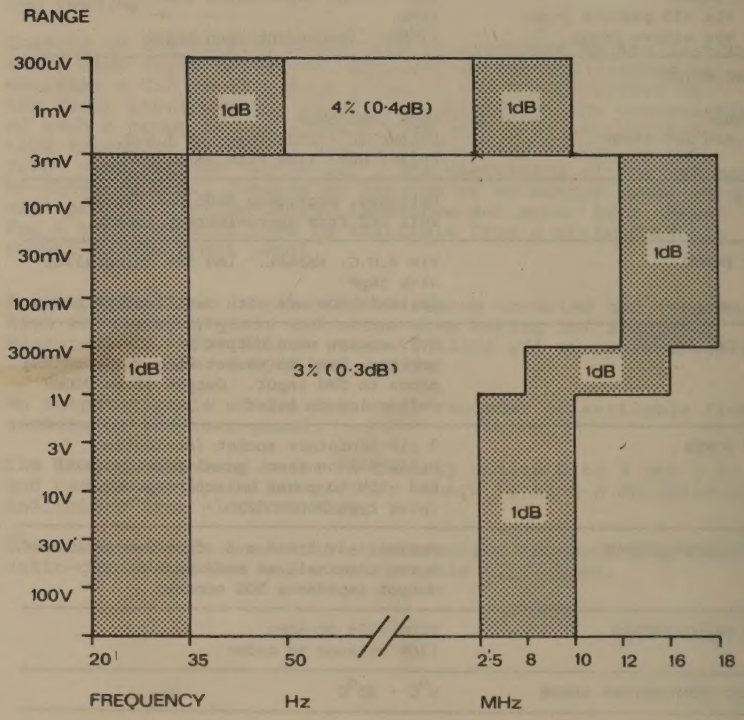
An output capable of driving a pen recorder is available from sockets on the rear panel.

The large, taut-band meter is clearly scaled 0 to 3 and 0 to 10 and has an anti-parallax mirror. There is also a dB scale with indicators from -10dB to +2dB.

The instrument is housed in an attractive two-tone grey case with satin-chrome handles and a retractable tilt stand.

SPECIFICATION

VOLTAGE RANGES	300uV to 100V f.s.d. in 12 ranges, 1 - 3 - 10 sequence
INPUT IMPEDANCE	
Direct input	1MΩ. Shunt capacitance 56pF
Input via x10 passive probe	10MΩ.
Input via active probe	>10MΩ. (Dependant upon type)
HUM AND NOISE	
3mV range	Less than 50μV
300uV and 1mV range	Filter in - less than 6% f.s.d. Filter out- less than 20% f.s.d.
FILTER	Switched, providing 20dB per decade roll off from approximately 100kHz
PROBE INPUT	Via B.N.C. socket. 1MΩ ±2% in parallel with 56pF Suitable for use with oscilloscope probe
PROBE CALIBRATOR	H.F. square wave output via B.N.C. socket. Used to assist with compensating probe to TM4 input. Output gives 300mV deflection on meter
PROBE POWER	3 pin miniature socket (Sealectro D102A052) on front panel provides +15V and -15V to power an active probe. (plug type S102A052)
PEN RECORDER OUTPUT	Nominal +1V for f.s.d. from 2mm insulated screw terminals on rear panel. Output impedance 50Ω nominal
POWER REQUIREMENTS	220V ±15% 50-60Hz 110V version to order
AMBIENT TEMPERATURE RANGE	$0^{o}C$ - $45^{o}C$



FREQUENCY SPECIFICATION

All limits are ± stated figure of f.s.d.

OPERATING INSTRUCTIONS

Installation

The TM4 is normally supplied set for use with a.c. mains supplies of 200-250V but a 110 version is available to order. Check that the instrument is suitable for the local mains supply before switching on. This information is marked on a label situated on the cable wrap on the rear panel. For 190-220V operation it is necessary to interchange the red and brown wires from the mains transformer.(The red wire is connected to the switch for 190-220V operation.)

The mains lead supplied is colour coded:-

Live .....Brown

Neutral .....Blue

Earth .....Green/Yellow

The unit is intended for use in an environment where the temperature is between 0°C and 45°C.

Operating Instructions

Connect the TM4 to the mains supply and switch on by depressing the black rectangular push button. The red 'on' indicator will now illuminate. By turning the range switch to 300mV and connecting the probe cal. output to the input via a short length of coaxial cable, a deflection of 300mV should be obtained on the meter. Remove the link after this test and the instrument is now ready to use.

Although the instrument can be connected directly through coaxial cable to the circuit under test, in some applications and particularly at higher frequencies, the loading of the circuit by the instrument plus the shunt capacity of the cable might prove to be a problem. In such situations a x10 oscilloscope probe will prove useful. Not only is the d.c. resistance raised to 10MΩ but the shunt capacitance is reduced too.

Plug the probe lead into the input socket and compensate the probe by turning the range switch to 30mV and connecting the probe tip to the centre pin of the 'probe cal' socket. Adjust the compensating capacitor on the probe to give a meter reading of 30mV The probe is now compensated and ready for use.

A higher input impedance and/or gain can be obtained by the use of an active probe. A positive and negative supply of 15V is available to power such a probe from the miniature three pin socket on the front panel.

Low frequency signals masked by high frequency spurious signals and noise can be measured by operating the bandwidth limit switch in the 100kHz position. A filter is then introduced into the amplifier which causes the signal to be attenuated at the rate of 20dB per decade from approximately 100kHz.

Gain versus frequency plots and similar measurements can be plotted by using the TM4 in conjunction with a sweep generator and X-Y plotter. (Suitable instruments are available from Farnell Instruments Ltd., and details will be sent on request.) An output of 1 volt positive is available to drive the recorder from two 2mm insulated terminals on the rear panel. The black terminal is connected to the instrument chassis. Output impedance is nominally 50Ω.

When using the instrument always start on a high range and switch down.

The meter scales are calibrated in r.m.s. values of sinusoidal inputs although the instrument is fundamentally mean rectified reading. For input waveforms which are not sinusoial the rectified mean value can be calculated as the indicated reading divided by 1.111.

CIRCUIT DESCRIPTION

The TM4 circuitry comprises seven basic stages. These are:-

1) Input attenuator

2) F.E.T. amplifier

3) Amplifier

4) Meter drive

5) Pen recorder amplifier.

6) Probe compensation.

7) Power supply

1) Input attenuator

The high impedance attenuator of the TM4 is of conventional design. Passive attenuation is used on all ranges except 300uV and 1mV where an extra stage of amplification is brought in. The attenuator design ensures a constant input resistance and shunt capacitance over the twelve ranges. This means that an input probe can be compensated on one range and used on any other without the need for readjustment.

2) F.E.T. amplifier

The transistors VT10 and VT11 form a high input impedance and low output impedance amplifier. The input impedance is predominantly formed by R11. Diodes D10, D11, D12 and D13 limit voltage excursions at the gate and so give some protection against input overloads. Low impedance attenuation is used on 3, 10, 30 and 100V ranges. Fine adjustment of attenuation on these ranges is by P10.

3) Amplifier

To prevent loading of the low impedance attenuator a common collector circuit follows. Amplification of the applied signal is by stages formed by pairs of transistors. The transistors are connected in a series - shunt feedback configuration. The advantage of this technique is a flat frequency response over wide bandwidths. On the 3mV ranges and above, VT13 and VT16 form one pair (i.e. one stage) and VT17 and VT18 the second stage. On the 300uV and 1mV ranges two additional transistors are 'steered' in by diodes. Transistors VT13 and VT14 form the first stage, VT15 and VT16 the second and VT17 and VT18 the third stage. On the 300uV and 1mV ranges, diodes D14 and D16 are forward biassed, with D15 and D17 reverse biassed, thus bringing in VT14 and VT15. The stage gain on these two ranges is set by P11.

On the 3mV ranges and above D14 and D16 are reverse biassed and D15 and D17 forward biassed. The signal passes from the collector of VT13 via C18 and C20 to the base of VT16.

The amplified signal from the collector of VT18 is fed via a coaxial cable link to the rest of the amplifier on the meter drive board. VT51 and VT52 form another feedback pair. The sensitivity of the basic system (i.e. 3mV range) is set by P51. A simple R-C filter, giving 20dB per decade roll off, is switched in by VT53.

4) Meter drive

The meter circuit used exhibits good linearity over a wide frequency range. The linearity is obtained by driving the rectifier diodes from high impedances. The collector of VT56 is high impedance and R69 is effectively a high impedance because of bootstrapping action by VT55.

5) Pen recorder amplifier

A single integrated circuit connected in a differential input mode is used to sense the current flowing through the meter. The output voltage is proportional to this current. An output of 1V positive referenced to chassis, is available to drive a pen recorder or similar equipment.

6) Probe compensation

This function is formed by a current mode multivibrator. VT104 and VT106 constant current feed the switching transistors VT103 and VT105. The cicuit exhibits good amplitude stability with temperature. P102 controls the output amplitude.

7) Power supply

Two supply rails are required for the TM4 - positive and negative 15V. The -15V rail is derived from a bridge rectifier and is zener stabilized. The +15V rail is derived from a series regulator. The integrated circuit is used as an error amplifier thus ensuring low ripple levels. VT101, R106 and R107 form a foldback current limiting circuit. The output voltage is controlled by P101.

MAINTENANCE

Guarantee

The equipment supplied by Farnell Instruments Ltd. is guaranteed against defective material and faulty manufacture for a period of twelve months from the date of despatch. In the case of material or components employed in the equipment but not manufacured by us, we allow the customer the period of any guarantee extended to us.

The equipment has been carefully inspected and submitted to comprehensive tests at the factory prior to despatch. If, within the guarantee period, any defect is discovered in the equipment in respect of material or workmanship and reasonably within our control, we undertake to make good the defect at our own expense subject to our standard conditions of sale. In exceptional circumstances and at the discretion of the Service Manager, a charge for labour and carriage costs incurred may be made.

Our responsibility is in all cases limited to the cost of making good the defect in the equipment itself. The guarantee does not extend to third parties, nor does it apply to defects caused by abnormal conditions of working, accident, misuse, neglect or wear and tear.

Maintenance

In the event of difficulty, or apparant circuit malfunction, it is advisable to telephone (or telex) the service department or your local Sales Engineer or Agent (if overseas) for advice before attempting repairs.

For repairs and recalibration it is recommended that the complete instrument be returned to:-

The Service Department
Farnell Instruments Ltd
Sandbeck Way,
Wetherby, Yorkshire
LS22 4DH
Tel: 0937 3541

or

Service Depot
Farnell Instruments Ltd
Hermitage Road
London N4

Tel: 01-802 5359

Please ensure adequate care is taken with packing and arrange insurance cover against transit damage or loss.

RE-CALIBRATION

For those who operate their own comprehensive service departments and wish to repair and maintain the equipment themselves, a simplified setting up procedure for the active circuitry follows. No instructions are given for setting up the input attenuator. If a fault develops in this circuitry the instrument must be returned to Farnell.

1) Monitor voltage between pin 1 (+) and 6 (-) on power supply board. Adjust P.101 to give a voltage of 15V ± 0.25V.

2) Monitor voltage between pins 10 (-) and 6)+). This voltage should be 15V ± 1.5V

3) Feed 3.00mV rms sine wave at 120Hz into the input socket. Adjust P51 on meter board to give 3.00mV meter deflection.

4) Turn range switch to 300µV and feed 300µV signal at 120Hz. Adjust P11 on main board to give meter deflection at 300µV.

5) Turn range switch to 3.0V. Feed 3.0V rms sine wave at 120Hz. Adjust P10 on main board to give meter reading of 3.00V.

6) Check that meter deflection (due to hum and noise) is within the limits specified.

7) Switch range switch to 3.0mV. Feed 3.00mV rms signal at 20MHz into input. Adjust C65 to give meter deflection of 3.00mV.

8) Monitor voltage across pen recorder terminals, with no input to TM4. Adjust P103 to give 0 volts on monitoring equipment.

9) Set range switch to 300mV. Connect 'probe cal' socket to input socket. Adjust P102 to give 300mV deflection.

10) Check that approximately 1 volt positive is available from pen recorder terminals for full scale meter deflection.

ERRATA & ADDENDUM

Alternative components to those listed on the circuit diagram may be used in the event of supply difficulties.

Major design changes are listed below:-

INTRODUCTION (page 2)
line 2 should read 'at frequencies up to 18 MHz

SPECIFICATION (page 3)
FILTER spec. should read 'Switched providing 20dB per decade roll off to be approx. 3dB down at 100kHz.

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